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LETTERS

AMERICAN KESTRELS (*Falco sparverius*) ADOPT AND FLEDGE EUROPEAN STARLINGS (*Sturnus vulgaris*)

*Frederick Hamerstrom often lamented about how the current state of science does not allow an investigator to deviate from his/her pre-planned protocol. His view was that unusual and interesting "side events" often were overlooked because time and money did not allow for such "unnecessary" investigations. In memory of Hammy, we present an unplanned study of a truly unusual event: the adoption of and eventual fledging of a brood of European Starling (*Sturnus vulgaris*) chicks by a pair of American Kestrels (*Falco sparverius*).*

In 1968 we placed 50 kestrel nest boxes on our 20 243 ha study area in central Wisconsin (F. Hamerstrom et al. 1973, *J. Wildl. Manage.* 37:400–403). An average of over 50 boxes has been maintained through 1990. In 1988 we started an intensive study and checked the boxes weekly during the breeding season. We caught and identified or banded any adults, and took notes.

In April 1988 we caught a pair of kestrels in the Rosen box. This pair initially had six eggs, but by 20 May only four eggs remained. On 24 May we found four young about 2–3 d old in the box. Four days later (28 May) the young had disappeared. There were scratches on the side of the box, which suggested predation by a mammal.

On 28 May the West Brandt box, 1.1 km from the Rosen box, contained six young European Starlings. Of these, four appeared to be dead, one dying, and one "still cheeping." By 0730 H we had caught the Rosen male kestrel on a *bal-chatri* near the West Brandt box and the Rosen female inside the box.

From the field notes: "May 28. Watch box [West Brandt] 0845–1045 H. Starlings fly to box about every 15 minutes with food [earthworms] in bill, but do not enter. If a starling flew in while the kestrels were out of the box, both male and female kestrel chased the starlings away.

June 3, 0550 H. Same banded female caught on five starling young. Female missing crown feathers. Left eye swollen and glassy. Perhaps wounds on head are from starling gapes?

June 3, 1545–1800 H. See male and female kestrel hanging in nest hole. Young starlings open gapes and crowd to hole. Kestrels appear to be placing small prey in starling gapes, but we couldn't see any prey. Male flew to perch near box with small, green, thin snake. Female perches next to male and then takes snake into box. Female kestrel stays in box about 10 min. Female catches mouse, brings it into box and stays ±15 min. Can see waving gapes while female kestrel is in the box, but not female feeding them. At 1800 H, check box. No signs of snake or mouse there! Female overhead circling.

June 4, 0600–0900 H. Set blind 38 m and second observer ±61 m from box. Female enters box with mouse but leaves after ±1 min with mouse. ±20 min later, female enters box with mouse—tears small pieces of mouse and places them in gapes of young starlings who lunge forward and place entire gape around female kestrel's head! Female kestrel feeds starling 2 more mice. Female [kestrel] mobbed by both adult starlings. One [starling] perches and hops toward box, female kestrel chases it.

June 5, 0600–1100 H. Female kestrel feeds starlings 4 mice—again starling gapes envelope female kestrel's head. Adult starling perches on top of and near hole of box. Kestrels not near. Starling leaves. Starling young call to adult starling, but more [vigorously] to approaching kestrels!"

[Note: every time the robins nesting nearby saw a kestrel coming back to the nest, usually with prey, they gave loud alarm calls—calls that the young starlings soon recognized as a "dinner bell." They responded by sticking their heads out of the nest box and waving their big, yellow gapes.]

"June 6, 0640–0820 H. ±0745 female kestrel lands near box with a partially skinned mouse—some fur on its back legs. She flushes three times before entering the box [perhaps to avoid further injury to her eye]. Finally she goes into the box and feeds the young for 18 minutes."

We saw two of the young starlings fledge; one flew 14 paces on its first flight. By 9 June the box was empty.

We have recorded the following on video: a female kestrel bringing food to the box and hanging on the entrance; the eager response of the starlings to approaching kestrels and their unusual indifference to adult starlings even when these entered the box; the female kestrel tearing slender, green snakes and voles, and placing the morsels in the starlings' mouths; and one starling fledging over the female kestrel's back.

We are deeply indebted to Hammy for his insatiable curiosity, and his interest in science. Ruth L. Hine and Jennifer A. Leak assisted in field observations.—**Michael F. Tlusty, Department of Biology, Syracuse University, Syracuse, NY 13244 and Frances Hamerstrom, College of Natural Resources, University of Wisconsin–Stevens Point, Stevens Point, WI 54481.**

NORTHWARD MIGRATION OF AN ADULT NORTHERN HARRIER (*Circus cyaneus*)

A nesting male Northern Harrier (*Circus cyaneus*) banded in San Diego, California (32°30′N 116°50′E) was found dead near Klamath Falls, Oregon (42°00′N 121°40′E) 47 d later, a straight line distance of 1175 km. Assuming the carcass was 7 d old (B. Waterbury pers. comm.) and that the harrier followed the most direct path northward, the average daily flight would have been a minimum of 29 km. Harriers are known to migrate south into San Diego County during the fall (P. Unitt 1984, The Birds of San Diego County, Memoir No. 13, San Diego Society of Natural History, San Diego, CA). Recent band recoveries indicate that juveniles may disperse northward to cooler climates (P.H. Bloom pers. comm.) as has been demonstrated for juvenile Bald Eagles (W.G. Hunt et al. 1992, *J. Raptor Res.* 26:19-23). Similar movements by adults have not been documented.

A pair of Northern Harriers was first detected in the lower Otay River Valley, 4 km north of the Mexican border on 8 April 1991, when a male was observed transferring food to a female. On 6 May, a nest was found in a dense stand of Black Mustard (*Brassica nigra*) on the south-facing slope of the river valley. It contained one egg and four young, the oldest young was estimated at 5–7 d of age (M.B. Saunders and G.L. Hansen 1989, *Can. J. Zool.* 67:1824–1827). Using minimum estimates of one egg hatching each day and a 31 d incubation period (F. Hamerstrom 1969, Pages 367–383 *in* J.J. Hickey [ED.], Peregrine Falcon populations: their biology and decline, University of Wisconsin Press, Madison, WI) the nest initiation date was estimated to be on or before 1 April, the earliest recorded in San Diego County (P. Unitt 1984, op. cit.). On 11 May, the female was brooding three young with no additional eggs in the nest suggesting either partial nest predation, cannibalism, or that the egg or small young had died and was removed from the nest by the parent.

The male harrier was trapped at 0800 H on 12 May 1991, 15 m from its nest using a *dho-gaza* trap with a juvenile Red-tailed Hawk (*Buteo jamaicensis*) as a lure (F. Hamerstrom 1963, *Proc. Int. Ornithol. Congr.* 13:866–869). The following measurements were taken: weight 365 grams, wing chord 340 mm, tail length 196 mm and tarsus length 793 mm. The bird was fitted with a color band and a U.S. Fish and Wildlife Service lock-on metal band on the right leg, and two color bands on the left leg. An 11 g tail mounted transmitter (AVM Electronics Inc., Livermore, CA) was attached to the number one and number two right rectrices using nylon ties and cyanoacetate glue. Total handling time was approximately 40 min.

The nest was checked again on 13 May and contained three young with both adults in attendance. The male harrier was last detected in the nesting area on 16 May 1991. On that date the female was perched near the nest while the male, initially located using telemetry, was hunting away from the nest for approximately 2 hr. A final check on 23 May revealed no juvenile or adult harriers in the vicinity of the nest and the three young were presumed to have been preyed upon. There was no evidence of intrusion by ground predators, however Red-tailed Hawks and Great Horned Owls (*Bubo virginianus*) were nesting in close proximity.

On 27 June 1991, the male harrier was found dead 11 km southeast of Klamath Falls, Oregon and taken to the Oregon Department of Fish and Wildlife. The bird was reported to be in deteriorated condition, dried out and picked clean by insects. It was estimated to have been dead a minimum of 1–2 wk. No cause of death could be determined. The bands were intact but the transmitter and the two tail feathers to which it was attached were missing.

These data were collected while we were conducting research funded by the Baldwin Company through Ogden Environmental and Energy Services (formerly ERCE). We would like to thank John Lovio for assistance in the field, and Patrick J. Mock for review of this manuscript.—**Mark A. Pavelka, Ogden Environmental and Energy Services, 5510 Morehouse Drive, San Diego, CA 92121; John K. Konecny, 1141 Morning View Drive #208, Escondido, CA 92026; Kristine L. Preston and Mary A. Grishaver, Ogden Environmental and Energy Services, 5510 Morehouse Drive, San Diego, CA 92121.**

ON THE ETYMOLOGY OF THE NAME *Bal-Chatri*

The *bal-chatri* (pronounced ball chat-ree) is a trap used widely to capture birds of prey for banding, thanks to the descriptions given by D.D. Berger and H.C. Mueller (1959, *Bird Banding* 30:18–26). Various modifications have been reported by other authors (e.g., D.D. Berger and F. Hamerstrom 1962, *J. Wildl. Manage.* 26:203–206; W.S. Clark 1967, *Eastern Bird Banding Assoc. News* 30:147–149).

Berger and Mueller (1959, op. cit.) mention that this trap was developed and used in India many years ago and that, according to F. Craighead and J. Craighead (1942, *Nat. Geog.* 81:247), the name *bal-chatri* means boy's umbrella.

I was recently in India teaching raptor capture techniques to Indian biologists. As the translation given above did not make much sense to me, I asked my Indian colleagues what the name *bal-chatri* means. The answer given was very logical. *Chatri* indeed means umbrella in Hindi (and most of the related languages spoken in northern India), but *bal* means hair, especially horse hair. When I inquired further, I found that it could also mean boy. The original

traps were cane baskets with horse hair nooses affixed; the baskets were shaped somewhat like umbrellas. So, it would appear that the most appropriate translation of *bal-chatri* is horse-hair umbrella. This translation does make sense and is the one that should be used.—**William S. Clark, 4554 Shetland Green Road, Alexandria, VA 22312.**

"GABBOONING" IN PLAINFIELD

How does one become a gabboon? I quote one of Fran Hamerstrom's letters concerning my application to be one: "I have many questions: Is the applicant healthy? Does she eat special food? Is she strong enough to carry a light ladder and climb up to the nest boxes to pull out the falcons to band them etc.? Has she ever taken care of any animals? Wild pets? Other? Has she a driver's license? Does she mind working alone? What does she want to do with her life after she finishes her studies? The research is fascinating, but hard work. Getting up early, heat, mosquitoes, nettles."

Reflecting on these questions and with no inkling of what awaited me, I sat on a bus to Madison, Wisconsin, in April of 1989. The permission to work for the Hamerstroms had reached me in Germany only 10 d earlier. After a 22-hr journey, I was welcomed by Fran and Hammy in Madison—with slight reservation. Immigration technicalities had caused me to be 4 hr late! We set off without further delay for Plainfield. All three of us had probably envisaged a smoother start to our three-month stint of working together on the "kestrel project"—with fewer mishaps and less tension. Nonetheless, we noted with relief that our plans had been realized. On the way to Plainfield, Fran began telling me, in her direct way, that my work would earn me free board and lodging, but that "such things as lipstick you must pay for out of your own pocket." I was just able to mumble that my need of cosmetics was not overwhelming, before falling fast asleep for the rest of the 2-hr drive.

We arrived outside of Plainfield, at this ancient, crooked and at first glance rather chaotic house, in the middle of the night. In a trance, I followed Fran to my room with one thing in mind—more sleep! As I lay on the bed, still rather dazed from the journey, and stared at the unpretentious surroundings and the cracks in wall and ceiling, I thought I would never be able to stay the course—a verdict which was soon overthrown.

The world, next morning, had improved enormously. The sun shone on a wonderful countryside and, after a short "scenic tour" of the enormous Hamerstrom estate, my initiation started—not with fieldwork, but with a reading by Fran from one of her books.

Without loss of time I was confronted by one of the Hamerstroms' guiding principles: research and public service Much has been written about their contributions to the former, and with this issue of the *Journal of Raptor Research* more honors will be added. But the engagement of the Hamerstroms in public service, and their ability to stir enthusiasm for nature in one and all, cannot be overstated. Nowadays it is more important than ever to sponsor interest in our environment. For decades, Fran and Hammy have contributed to this effort enormously, not only with their lectures and books, but with their "gabboon system."

What is this enigmatic-sounding helper system? In fact it is no great secret. Quite simply, it consists of engaging people of all ages, but principally youngsters, as scientific workers, in which a lack of training is no hindrance. As for "gabboon"—the word stems from an African expression for slave. One quickly learns the essentials for efficient work, for instance distinguishing male raptors from females, banding the birds and writing field notes. Especially in more recent years, nearly all the fieldwork has been undertaken by the gabboons.

As I was fresh out of school, the amount of responsibility given me and the freedom in conducting fieldwork were fascinating. I have since learned to value this all the more, having spent 2.5 years at German universities, interacting with sometimes condescending professors.

Ever since the prairie chicken project, it was necessary for the Hamerstroms to trust their helpers completely, to give them responsible jobs, and to keep explanations and instructions to a minimum. Two persons (not even Fran and Hammy) cannot be everywhere on the booming grounds at all times! As a result, through the years over 7000 helpers were given the opportunity to experience nature first hand and to make the acquaintance of extraordinarily fascinating people.

In exchange, Fran and Hammy have amassed a tremendous knowledge of human nature, together with the ability to evaluate quickly the reliability of the reported observations and to check them themselves if necessary.

For me, work on the kestrel project began by accompanying Fran over the study-area in a VW-Bus. She tested whether I could orient myself to the compass directions and find nests with the aid of a map. We checked a few nestboxes but found no kestrels except for one dead individual at the bottom of a box. I shouted the news to Fran, standing down below, but against the fresh April wind she understood only "kestrel." She decided I needed immediate help and plunged through the ice-cold, knee-high water in a ditch, which I had already crossed, ladylike and dry, using my ladder as a bridge. Going back, we both balanced single-file over the ladder, laughing. Apart from Fran's agility at her advanced age, and her habit of letting off steam, her disregard for inclement temperature is astonishing.

When I first arrived in Plainfield in April, she trotted to the nearby pond every morning to bathe. She visited us barefoot in sandals in Germany in January, 1991, then on she went to Africa, which Hammy had always refrained from visiting because of the heat. Hammy was of more even temperament altogether, but precisely because of his unflappable personality he was no less lovable.

Perfectly composed, Hammy showed me how to band a bird—demonstrating on the dead falcon we had found! That was the extent of my introduction! Within days I was on my way alone through the marsh when I discovered a nestbox that contained my first live bird. Once again high up on the ladder, I quietly dropped the "hole-plugger"—a sponge on a long stick, used to cover the nestbox entrance—thinking I wouldn't need it. I grasped my first falcon safe in my right hand, and was all set to carry it down the ladder to the bus for banding and weighing. At that moment I spotted a second falcon in the box. Quick as thought I plugged up the nestbox hole with my right elbow. Number two was safe in there, at least. But now the first bird took firm hold of my left hand and so we stood for awhile, swaying atop the ladder—I suppose you could call it a vicious circle. With aplomb worthy of a circus actor I raised one leg and managed to whip off a shoe to plug the hole. During the next days, Fran never tired of repeating the story again and again, while Hammy merely smiled and asked me how many limbs I had.

Such unforeseen situations occurred frequently, so that improvisation was the rule rather than the exception. The frequent wracking of nerves and need to adapt were gladly suffered as a price for independent work. Fran and Hammy had realized, early on, that "spoon-feeding" and control would never have taught the gabboons to act spontaneously and independently in unusual situations—which are always cropping up when one is dealing with animals. With their antithetical methods they achieved dedication to the "own" project and keenness to work. Perhaps only those who have experienced a similar training can appreciate the procedure.

Nevertheless, it wasn't that the gabboons were left without any possibility of help, and faced with intractable problems. The Hamerstroms were always available to answer questions—except for Fran when she was busy writing one of her books—and of course they expected to be given the most detailed reports on all aspects of the project. There followed comments which ranged from severe criticism to heartfelt praise. Fran and Hammy always volunteered their frank opinion, and expected a high performance in their gabboons. This made the work in Plainfield wonderful, but also wonderfully strenuous!

That the working atmosphere was so open and personal was surely because the gabboons and the Hamerstroms lived together in this beautifully quaint house in Plainfield. It was the life of a family, and friendships developed fast

Yes, I learned a great deal in Plainfield: to wash up silver cutlery separately from the stainless-steel variety, not to put fork-handles of bone in water; to nap after lunch, to give vegetables not water to mice, to charm an owl into cheerfulness and a thousand other golden "household-rules."

Above all, however, I learned to act independently and on my own initiative, and I have the firmly rooted knowledge that people work all the more efficiently the more freedom they are given.—**Sabine Strecker, Moosbachstrasse 11, 7801 Buchenbach, Germany.**

WHY ARE YOU REALLY HERE?

There has been a recent flurry of activity in governments and universities to encourage women in science, yet some women were in science long before these special programs. It is this aspect in part we wish to discuss. Neither of us has remained in ecology but both of us are still woman scientists, perhaps in part owing to the Hamerstroms. We both had some interesting discussions, particularly with Fran, about women and their role in biology.

THE GERRARD STORY

"Why are you really here?" This is the question that Fran Hamerstrom asked me when I first met her, over twenty years ago. The question was not new to me, as many who worked in wildlife had asked me this before. The difference this time was that Fran was a woman and the others had all been men. Fran wanted to know what was going on in my life that I had showed up at her Plainfield, Wisconsin farmhouse wanting to know about her mews and about eagles. On the other hand, the men had all wanted to know what ulterior motives I had for being in the field, and they insinuated that I used my interest in wildlife biology in order to find a husband. The question, coming from Fran, was a refreshing change. The question was directed at me as a person, not as a genderized object.

That night Fran and Hammy and I talked about why I was "really there" and their enthusiasm and direction, in addition to caring and thoughtful interest in me, drew me closer to them. The next morning Fran showed me the "kestrel circuit" as we went out and banded young kestrels. That afternoon, she asked me to clean the refrigerator as the dead owl stored within had maggots. It was my first "test" and I was determined that Fran and Hammy would find no reason to judge me less highly than anyone else, male or female. Indeed, after this first test I felt totally accepted, not only as a person, but as a woman in science, one who could "hold her own."

Over time, I spent many weekends with the Hamerstroms. I never really became a typical Hamerstrom gabboon, but I often shared in the varied and fascinating life at the Hamerstroms. Sometimes I participated in observing in the field, or banding. On any visit there, I may have found another visitor, perhaps a falconer from Europe, or a raptor researcher from some other state. On one visit, I "purged" a tapeworm I had acquired from fish eaten while I was in the field banding bald eagles. I blended in and spent many hours, particularly with Fran, talking about her early years in wildlife biology, with Darlington, Leopold and others.

Fran had very strong ideas about the role of women in science and in relation to men. In the early 1970s Fran was my first role model of a woman who had entered a "man's" field and had succeeded. She awoke in me the dream that I, too, could overcome the sexism rampant in wildlife biology, and achieve what I wanted. Although I subsequently abandoned the professional career of a wildlife biologist, and went on to get a Ph.D. in Community Psychology, Fran has been my touchstone. At many times I have said to myself, as I pursued my own career interests, "What would Fran say or do?" Her work with raptors, her writing, and her ability to overcome, in her own way, the sex-role stereotypes that have oppressed women have been an inspiration for me.

I first visited Fran and Hammy because I really was interested in raptors. I really was interested in her mews. I really was interested in wildlife biology. I really was interested in meeting a human being who would accept me for all of that and nourish me as a person, as a woman in science. In recognizing all that, Fran gave new meaning to the question "Why are you really here?" and for that I will cherish her all my life.

THE SCHMUTZ STORY

I met Fran and Hammy in 1970 through Joe Schmutz, their live-in foreign summer student. Joe brought me home to meet the Hamerstroms when his VW bus broke down and needed towing. Fran and Hammy never quite believed that was why I was there. In any case, a feast was prepared—fondue on the front porch. Fran believed in welcoming people with food and Hammy enjoyed that part of all the company the most I think! Knowing Fran, pleasing Hammy may have been the primary reason she did it.

Within a short time of my arrival I was given my "test." Fran asked if I would feed the owl using part of the raccoon in the refrigerator. I know I passed the test because some twenty years later I still feel welcome when I visit the house on the marsh.

Fran and Hammy believed that couples should understand each other's work, which should also be their passion, and preferably work together. It was a great disappointment to them that I left ecology for genetics after my Master's and thereafter did not go into the field with Joe. Nevertheless I always felt encouraged by them that I too should pursue the aspect of science that was my passion. Hammy and I spent many evenings doing dishes together after one of Fran's delicious meals discussing my work and my aspirations. In his quiet way he always affirmed that he believed in me. He used to say that genetics had too many numbers for his liking but that he admired my tenacity in sticking to them. That was one of the wonderful aspects of the Hamerstroms—their nurturing of young people into science (and art) and their openmindedness even when we chose to diverge from the path they had started us along.

Fran was one of the few female role models I had in those days. All my biology professors were male then and for some years to come. I remember her advice that a woman who worked so closely with men in the field should dress as much like them as she could, with no makeup or frills. Until of course she went to a cocktail party or banquet at a conference with them where she should don her most alluring dress! She also instilled the notion that it would not be easy to be accepted as a woman and that we must try harder. Not that this was right, just that it was. Hearing this from her when I knew she supported my efforts was much easier than experiencing it with no forewarning, I believe.—**N. Gerrard and Sheila M. Schmutz, c/o Department of Animal and Poultry Science, University of Saskatchewan, Saskatoon, SK, Canada S7N 0W0.**

DEAR FRAN

I think that the circumstances of my tenure with the Hamerstroms bears repetition. While a student at the University of Wisconsin at Stevens Point, I had been "booming" twice. Then after 2 yr in graduate school in Minnesota, as I was entering an elevator in St. Paul, I heard Professor Tester say to Professor Marshall, "We need three students to go to the Hamerstroms' this weekend." I piped up, "I'll go, and I can find the other two, too." As a result of this visit, I ended up spending the summer, and 2 yr later found myself trapping Hen Harriers in Orkney with Eddie Balfour.

My reason for recounting all of that goes back to my first one-on-one contact with Hammy. After spending the dusk hours of my first field day at the Hamerstroms' on top of the Kombi alternating between spotting scope and reading in the banding book, I drove back to the house leaving the banding book topside. What a commotion that caused when it became apparent what had happened. I was delegated to tell Hammy with my head hung in shame. His words still echo, "Well you'd *better* find it!" This was not the abusive response I may have deserved, but there was no question

as to the seriousness of my transgression and the response expected from me. I still remember ironing the pages of the notebook that had gotten wet before it was found. That first evening was the beginning of the greatest learning experience of my life.

I remember so fondly the two favorite names that you called Hammy in my presence. The first was when we were looking for his approval of a manuscript or scheme, and you would refer to him as "Maestro." I feel that this was a very accurate description of his nature. He was an eminent composer, conductor and master of the art. That art was, of course, the written word, which somewhere along the line includes analytical thought as well. It is doubtful whether I or any number of gabboons would have ever written anything without Hammy's help. That help was always firm, frank, and often painful for me; but one could never say that Hammy was unkind in the process. Indeed, I can picture myself squirming in discomfort after a good "editing," and Hammy finding something so nearly absurd about my attempt at self expression that it started both of us laughing. For this, I owe Hammy much.

The other name you used for Hammy was "Gesichtelle," which literally translated means "little face." This was strictly between the two of you, but I believe it to be a term of endearment, and observed your use of it in special situations where appeasement of the "Maestro" seemed in order. Indeed, N. Tinbergen and K. Lorenz showed that this sort of behavior maintained the pair bond in many organisms. I should have learned that earlier in life.

Even as a gabboon, Hammy treated me with respect, and played the generous host beyond all expectations. We could be having a raucous writing session in the back room over a jug of MP, when Hammy could be heard, "Bill, are you in? How about you, Fran?" Usually that meant martinis for a select few before bed and the winding down of the more strenuous activities.

There are many such memories, such as the inadvertent crack left in Hammy's net door which allowed Ambrose to get into Hammy's office, the great pleasure you both took when we flew the owls indoors at night, and "mouse television." So many words added to my vocabulary: "stocking mail," "go topside," "Kombi," "George's Stomach," "do a walk-in to the nest," "Fuzz," "Cuzzin Ray" and much more.—**William C. Scharf, Biological Sciences, University of Nebraska, Lincoln, NE 68588.**

THE HAMERSTROMS, A MEMOIR

It's January and time again to throw a *bal-chatri* for wintering kestrels. The birds once more are perched on the lines in the rural areas of coastal North Carolina where I now live, but with each bird I ensnare, my mind drifts back to another day and another place—and to the always delightful company of Frances and Frederick Hamerstrom.

My recollection goes back to the Christmas season of 1973, or maybe it was 1974, when a well-used—some might say ramshackle—Volkswagen bus clattered into the parking lot at the Welder Wildlife Foundation in southern Texas. The snows and bitter cold of Wisconsin were far away once more. Fran and "Hammy" had arrived.

The Hamerstroms were a legend in their own time. I'd heard of them since my student days, of course, as had just about anyone with an interest in wildlife, but now here they were in person. Fran, hair askew, in her flannel shirt and well-worn jeans scarcely resembled the debutante and fashion model she once had been. Indeed, as I got to know her better, I suspect she gleefully "played" to the contrasts of her then-and-now image. (See page 5 of Fran's marvelous book *Strictly for the Chickens* for a photo of a *verrry* fashionable young woman poised elegantly on an impressive staircase.) Hammy, dashing in his magnificent snow-white goatee and mustache, immediately transmitted an air of quiet competence, warmth, and civility for which he was widely known (*Wildl. Soc. Bull.* 19:119–122; see also 378–379).

So, here the Hamerstroms were in person, replete with what was for me an arcane collection of wire, loops, tubes, and caged birds stored rather randomly inside and on top of their much-traveled bus. Fascinating days lay ahead.

In the winters following their so-called retirement, Fran and Hammy had begun fleeing the Pleistocene-like environment of Wisconsin, trapping and banding raptors *en route* to the more compatible climes of Texas and Mexico Harris' Hawks were their special interest while staying at Welder, before heading on to Mexico to study Ospreys, but there was always time for banding another redtail or kestrel, and certainly for discussions of Northern Harriers—Fran, I think, was one of the first to champion renaming "marsh hawks." Northern Harriers remained a special interest for Fran, although Hammy, as always, was dutifully involved with the work, whether in the field or as a reviewer of manuscripts (he was renowned for his precision with words). Fran's studies of harriers spanned some two decades and included data on more than 200 nests and almost as many color-marked breeding adults. Of the papers resulting from this volume of long-term information, one in particular stands out—for me, at least—because it clearly links the importance of prey abundance on the reproductive efforts of predators (F. Hamerstrom 1979, *Auk* 96:370–374). This work eventually led to a book-length treatment, entitled "Harrier, hawk of the marshes: the hawk that is ruled by a mouse" (1986, Smithsonian Institution Press, Washington, DC).

In Texas, the harriers and Prairie Chickens of Wisconsin were left behind in favor of Harris' Hawks. And it was

in search of these interesting birds that I learned first hand of the paraphernalia of capturing and banding raptors. *Bal-chatris* were especially captivating for me and, more importantly, for a good number of Harris' Hawks as well. My experience with such devices was nil, and so I quickly became the newest of their many "gabboons," the Hamerstroms' quaint name for apprentices. According to Fran, "gabboon" stems from Africa, where, with a slightly different spelling, the term refers to those of a wretched tribe who are forced into servitude by a more powerful tribe. During the field season in Wisconsin, the Hamerstroms often had a houseful of such volunteer laborers at hand. Tales of the cuisine served to the gabboons, while no doubt enhanced by their repeating, nonetheless stir the workings of one's gastrointestinal system. "Roadkill stew" has since become a staple in my vocabulary, but not—I think!—as an entree on those occasions when I shared a table blessed with Fran and Hammy's cooking.

So off we went one fine day, mentors and new gabboon. Down to Kingsville, then off toward Falfurrias. Harris' Hawk country. The bus clattered, but on it went under Hammy's steady control. Fran was busy boiling water for tea on some kind of stove when Hammy spotted the first bird. Out went the *bal-chatri*; Fran lowered the trap from the moving bus with the same grace as she had descended those stairs so long ago. A quick catch. The bird was quickly immobilized inside a plastic tube—so that was what they were for!—again with the effortless grace that comes with long experience. Another bird along the roadside, this one with a companion nearby. With *bal-chatri* again in place, Hammy gunned down the road, turning the bus around with his own style of creative driving that comes from years of field work on narrow roads. Success again, but this time both birds wheeled to the trap and both were soon hopelessly tangled in the nooses. I'm not sure, but I'd guess that the Harris' Hawk may be the only species in which two (or more?) birds might be captured at once in a *bal-chatri*. In any case, untangling those two unhappy birds was another event etched so deeply in my memory of days long ago.

By now the water was ready, so a tea break was declared, followed by subjecting each bird to careful measurements, some of which appeared in print (F. and F. Hamerstrom 1978, *Rapt. Res.* 12:1–14). What seemed to be an unusual molting pattern, especially in the primaries, was of special interest and a good deal of time was spent examining the wings of every Harris' Hawk caught by the Hamerstroms. They had published a paper on their method of recording molting patterns (F. and F. Hamerstrom and J. Wilde, Jr. 1971, *Inland Bird Banding News* 43:107–108), and diagrams with their most current data now were stacked in the bus in a filing system whose working were known only to Fran.

Tea finished, we searched for more birds. Fran and Hammy were sharp-eyed and could spot a perched hawk of any kind with ease. My education was advancing, albeit slowly. I was to arrange the loops, opening any that had closed and setting them upright, but most of the time I just caught my fingers. The day wore on, with a tally of a few more Harris' Hawks for our effort. My work with the nooses improved, but never really to the satisfaction of Fran, who always was able to locate a misguided loop or two. Hammy just smiled—I suspect he'd witnessed a similar scene more than a few times before. And so it went.

The Hamerstroms' ventures to Texas and Mexico strained their retirement income, or at least that's what they said, so Fran used their long drives as time for writing for profit. At some point, I don't know when, she developed an interest in children's books and drew from her own experiences as a mother for material. "Walk when the moon is full" (1975, Crossing Press, Freedom, CA) was a result of this effort. Other experiences in their eventful lives also served as the basis for delightful stories, among them "An eagle to the sky" (1970, Iowa State University Press, Ames, IA) and "Strictly for the chickens" (1980, Iowa State University Press, Ames, IA). Scientific reports, of course, continued between these and other popular writings.

Hammy's gone now, but Fran carries on. I tried to phone her recently, just to see what she was doing, but I was unable to reach her. No doubt she still watches the prairie chickens dancing in the freshening Wisconsin spring and maybe even finds the energy to search for a few harriers' nests. I hope so. But whatever the case may be, I shall retain the rich treasure of recollections of Fran and Hammy going full force. Those, indeed, were fascinating days.—**Eric G. Bolen, The Graduate School and Department of Biological Sciences, University of North Carolina at Wilmington, Wilmington, NC 28409.**

A KESTREL TO THE SKY

An eagle's stature, of course, is much more impressive than a kestrel's. But, as Niko Tinbergen once wrote to me, kestrels are "sweet." Being highly adaptive in their behavior, these small falcons are distributed all over the World.

I have kept, bred and raised quite a lot of falcons, including European Kestrels (*Falco tinnunculus*) from in or near the town of Freiburg in southwestern Germany, American Kestrels (*F. sparverius*) caught near Plainfield, Wisconsin, and their descendants. [1 2]

When my husband, Otto Koehler, and I arrived at the Hamerstrom farmhouse in 1960, there were already five American Kestrels waiting to be taken to Europe on board the S.S. Nieuw Amsterdam—but this would be a story of

its own. There were also a Northern Harrier (*Circus cyaneus*), a Snowy Owl (*Nyctea scandiaca*) and a hand-raised Great Horned Owl (*Bubo virginianus*) that was allowed to come into the sitting room in the evening. The owl played with balls of wool like a kitten and nibbled at our ears, very gently as he probably thought.

We had some wonderful days with Frederick and Frances Hamerstrom. The first evening, Fran took me, more or less blind in the dark unknown environment, to a nearby pond and we bathed, alone under the high vault of the sky except for some turtles plunging into the water. Otto and I learned how to catch kestrels and to keep them in beer cans until they could be weighed and measured. We met Helmut Mueller and other young biologists who netted passerine birds for banding near Lake Michigan. Whatever we found dead at the roadside, squirrels and other animals, was taken home as food for the birds. When I cared for my kestrels Fred watched me silently. At last he said "She has a wonderful hand with them," which I can still hear today.

On 23 August we left for the meeting of the American Ornithologists' Union in Ann Arbor, Michigan. While on a toll highway we had a tire mishap, but Fran mastered the situation calmly smoking her cigarette. Only the kestrels were very much upset.

Next day, in Ann Arbor we met Margaret Morse Nice and her husband, whom we had visited in Chicago, Ernst Mayr, and, for the first time, Amelia Laskey. I had had some correspondence with Amelia Laskey since American ornithologists helped European ornithologists after World War II, a system organized by the Hamerstroms. We participated in the meeting for only one day. We had to go back to New York and board our ship.

In 1991, when Fran came to Freiburg again, on her way to Africa to go hunting with the pigmies, we talked about falcons and she advised me: you must write popular books, otherwise your book will never be written, with all that literature. . . . Therefore, although I still hope to publish at least some of my observations, I dare tell the story of just one of my European Kestrels in an informal paper for this Hamerstrom Issue.

The kestrel was a male named Fridolin whom I kept in an aviary for 6 yr and who afterwards lived flying free for another 7 yr using me as a food resource for himself, his mate and his young. In winter he sometimes stayed away for weeks or even months.

FRIDOLIN'S LIFE

The kestrel was brought to me as a juvenile in February 1973. I do not know his previous history. He was tolerant but not very tame. In summer he lived peacefully with an adult female in a large aviary (6 × 4 × 4 m) in Wittental, a village near Freiburg, Germany. Neither of them courted. The winter months were spent in an aviary at my house in Freiburg, and the kestrels came to Wittental again in March 1974. The male, now in adult plumage, flew demonstratively to the potential nesting site where he called "zick-zick," but they did not get further.

After the summer of 1974, the pair stayed in Wittental all year. During winter they were allowed to use the three neighboring aviaries (all of the same size), both with and without other falcons. This gave them access to sunshine whenever possible—besides in spring, from 1973 onwards, some artificial illumination which they liked especially for warmth.

In 1975 and 1976 they had seven eggs each year. Four and three young, respectively, hatched and fledged. All eggs were fertile, but some of the chicks were too feeble to hatch. I suspect that the male brooded too long, which is a problem in raptors breeding in captivity (pers. observation). In the wild, the male has to go hunting. He relieves the female about twice every day while she feeds and preens. In the aviary he can just stay and sit until the female wants her turn. But he has no brood patches, and apparently cannot incubate adequately for long periods of time.

When the pair started to breed again in 1977, a marten (*Martes* sp.) found his way into the aviaries. On 2 May the female had disappeared.

Next spring the male courted a female Lesser Kestrel (*F. naumanni*) × European Kestrel hybrid. But when I obtained another adult female European Kestrel at the end of April 1978, he courted her and chased the hybrid. The females looked similar and behavioral differences were subtle, but the European Kestrel is the bigger species and in raptors big females seem to be attractive for males. This female, coming from a small zoo in Waldkirch where she may have been attached to another male, started laying unfertilized eggs the day after her arrival.

Neither repellents nor tasty baits in a trap box allowed me to get rid of the marten. He could no longer enter the cages, but he chased the birds from outside sometimes injuring them. Not having sufficient room for all the birds in Freiburg, I released the European Kestrels near my house at the edge of town. The birds were used to catching live prey, but, in January 1979, there was snow to worry about. None of the birds I had hacked back at the site or elsewhere, young or old, had stayed or come back and neither did the female. The male returned 3 d after release and stayed, with interruptions, for 7 yr to come.

In spring he often cached surplus mice at the wood's edge or in the garden, mostly under roots, logs and bushes, sometimes on the roof or balcony; but never more than one piece in one place. His new mate, an unidentified female to whom he had carried food for a few weeks sometimes came alone to look for his caches. How she found them is unclear. Maybe she searched the most promising structures (edges, corners, holes) which is difficult in the wood. Fran Hamerstrom suggested, he may have left some droppings. At any rate, my kestrel was breeding again, in his first year of freedom, and he did so every following year until he disappeared in February 1986.

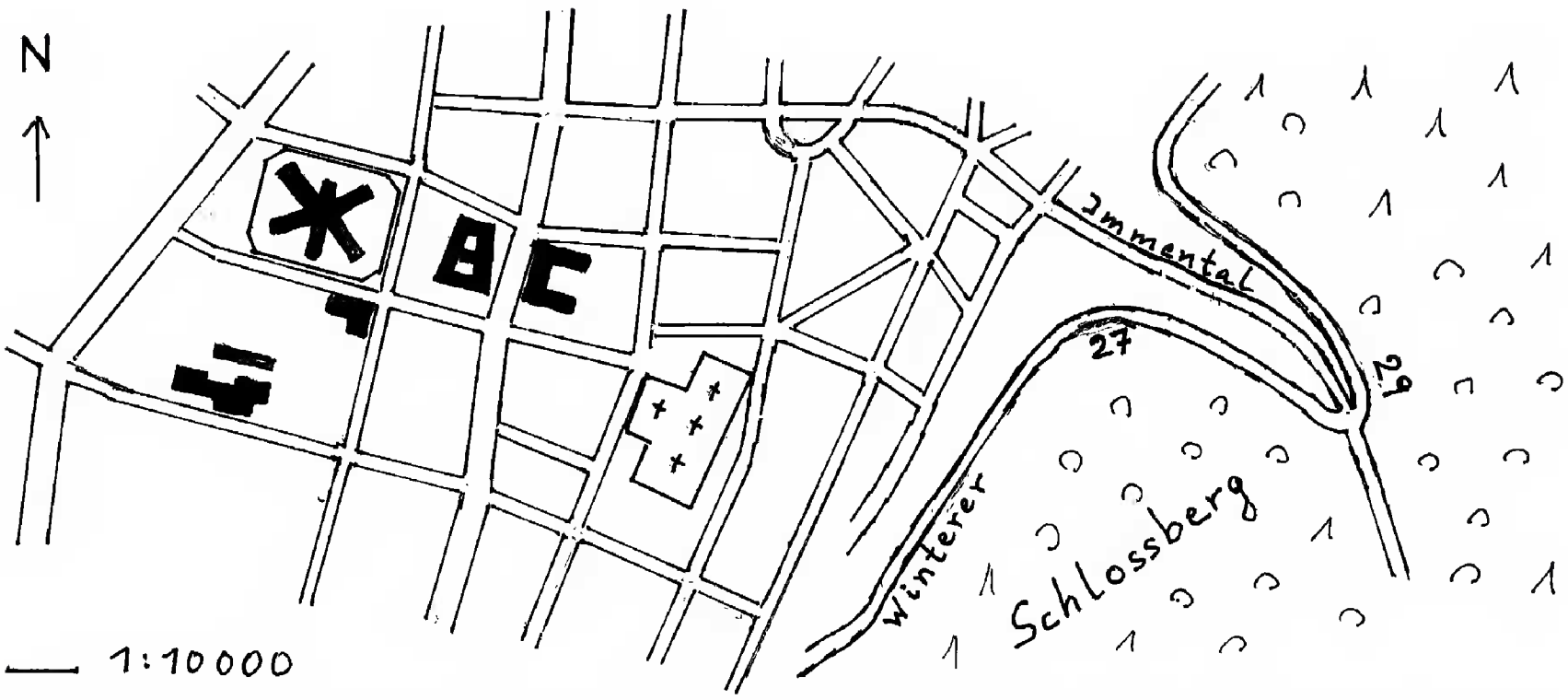

Figure 1. Section of the map of Freiburg city. From right to left: Wintererstrasse 29 (my house), Wintererstrasse 27, old churchyard, gymnasium, Herder Publishers, the jail, north of the campus where the big Chemical—in front of small Zoological—and at the corner the Physical Institute was located.

Since Fridolin always flew in the direction of Schlossberg (Fig. 1) I suspected him to nest there in a hollow tree or on a crow's nest. I searched in vain. At last I followed him by car. He flew along Wintererstrasse up to No. 27, then headed for the city. Sometimes he landed in the trees of the old churchyard, sometimes at the gymnasium or the publisher's. I lost him from my view and though I searched these places I never found the nest. Finally, we gave him a young rat, about twice the weight of the usual mice, and then he flew straight to the jail. There were three young, about 3 wk old.

This was in June 1983. He had probably nested there since 1979 for I knew there were kestrels. At the end of July 1980, I observed a young bird twice near my house and noted: the kestrels at the jail fledged as late as this one, which probably was one of them. I now watched the male carrying white mice to his young and for proof I asked a jailer, since I was not allowed to go in, to collect some pellets: They are white, partly mixed with some gray hair of wild mice and a few chitinous remains of insects.

On 2 July 1983 after the young fledged I saw one of them tumble down and disappear from view. The female flew down toward it. This young survived the fall, but I was told that there were dogs in the yards during the night, a potential danger for fledglings.

In 1984 the kestrel had a second female and two nests on the two sides of one block with the roof between them. The secondary female was a young one.

Trios have been reported several times in European Kestrels (G. Matthäus pers. comm., W. Scherzinger pers. comm., pers. observation) and Lesser Kestrels. [3] Altenburg et al. [4] and Hamerstrom [5] have studied polygyny in harriers (*Circus* spp.) and Newton [6] lists 11 species of raptors with known cases of polygyny; these apparently depended on favorable environmental conditions, mainly food abundance.

FEEDING

Usually, I offered Fridolin live white mice on the lawn or on one of two balconies, rarely young rats or 1 d old chickens, exceptionally chicken necks or beef heart. When he felt safe, he gripped the mice at once, killed them by biting their forehead between the eyes and ears (not the nape of the neck, this by kestrels is only done with bird prey), then started for his favorite feeding place in a large beech tree. At other times he took only a few bites and carried the rest to the nest site. Sometimes he flew directly to the nest or cached his kill and came back for another mouse, on occasion repeatedly. He also caught what I threw into the air. Sometimes, when his mate or young had followed him, he presented them with food right here

By his eagerness and the number of prey items Fridolin needed, I could judge whether he had a family. During 2 yr we recorded all items (Fig. 2). The high peak in June 1984 seemed unusual. He then had two females and, unfortunately, the mice I could offer him were small, about half the weight of adults—though this is not unnatural, for in the wild young mice will be easier to catch than experienced ones. The 1985 curve seems to be more characteristic.

One day, Fridolin chased a bird, probably a Robin (*Erithacus rubecula*), nearly colliding with a car. He finally caught the bird and flew onto the roof of the house to feed

He even tasted fried chicken. My dog Mira went out

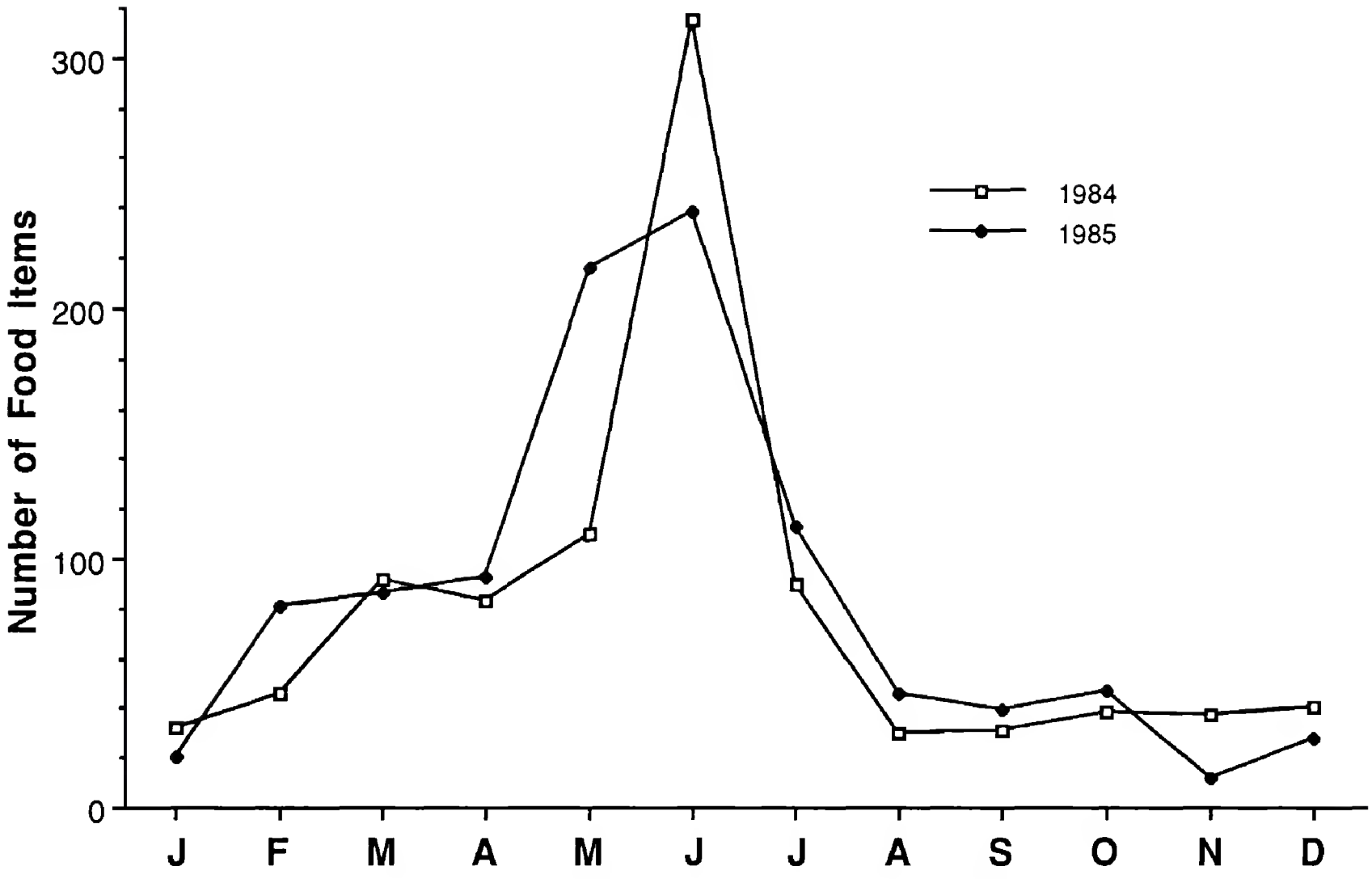

Figure 2. Number of mice and other food items taken per month in 1984 and 1985.

into the garden with part of the carcass (backbone and ribs), some meat and the lungs still adhering. She left it lying on the grass. To my surprise, the kestrel came down from his perch, settled on the chicken bones and fed, evidently enjoying his meal. Having finished, he cached the remains. This did not look similar to anything he had eaten and did not move. Mira had never served him before. How did he know it was edible?

Learning and Communication

When Fridolin had to care only for himself, he usually came once or twice in the morning and again in the afternoon, depending on daylight. While he raised young he came once more in the evening, or even throughout the day.

Until September 1984 I had a study room in the Zoological Institute. As it seems, the falcon had learned when he could expect me to be at home. He waited on his favorite perch, the tip of a very high spruce. Often he stayed there until I had come up to the house. At other times he followed me through the garden, and when he was in a great hurry he even came down to the gate, followed me into the wood where I went with the dog or even flew towards the approaching car.

The highest building on the campus is the Chemical Institute. During courtship the pair often spent several hours a day on its flat roof and the balconies facing my window in the Zoological Institute. Thus, at times, I could keep record of what they did. But, evidently, the male observed me also. More and more frequently we arrived at home at about the same time. He could see me as I left the Institute and went to my car. No doubt he had learned that this meant I would be at home soon, and I am convinced that he sometimes followed my car.

From the roof of the Physical Institute I could watch him flying to the nesting site and back to my house. The shortest time it took him to catch two mice he brought to his mate was 5 min, with a flight distance of 1.5 km one way. He glided up the roofs and sailed to the next ones saving energy for his many flights to and from. Driving home, I sometimes saw him pausing somewhere in Immental street which, as far as I know, was formerly not his route.

Generally, he used visual signals to make me aware of his presence, when he was not able to just sit and wait Sometimes he uttered an excited "kli-kli-kli," but then, in most cases, there were dogs or crows or something else that disturbed him. It may have been also a sign of impatience, but I doubt that he intended to call me—something my Tawny Owls (*Strix aluco*), coming at night, certainly and successfully do.

COMPETITORS AND PREDATORS

Perhaps attracted by the birds in the aviary, a male kestrel used to catch mice near my house from the end of December 1969 to the beginning of April 1970. He, too, learned to wait for me at certain times and to make me aware of his presence. In later years, there were sometimes young I had raised. Other adult kestrels came only exceptionally. Thus, there was no intraspecific competition.

Red Fox (*Vulpes vulpes*), Badger (*Meles meles*), weasels (*Mustela erminea, M. nivalis*), Beech Marten (*Martes foina*) and domestic cats (*Felis catus*) visited my garden. They may have found some caches and this might have caused Fridolin to carry away his prey to some prominent buildings in his nesting area: the jail, the Chemical Institute and Herder Publishers.

Carrion crows (*Corvus corone*) sometimes waited in the trees and tried to steal what he kept in his talons. They were mobbed and chased. Once a jay (*Garrulus glandarius*) killed a mouse running in the grass while the falcon looked at it. The jay seemed to be an experienced hunter.

Blackbirds (*Turdus merula*) attacked the kestrel while they had young and for good reasons he was very cautious with them. They mobbed him furiously. Once a cock hit him so badly that he sat on the ground numb for a few seconds.

Fridolin's most dangerous interaction occurred with a buzzard (*Buteo buteo*). The buzzard had discovered that he could easily catch mice here and it was my fault not to drive him away from the beginning. Once, he stooped down onto the falcon who was attempting to catch a mouse in the grass. The kestrel was quicker and more maneuverable. The kestrel chased the buzzard extensively, but after this fearful experience he never tried to hunt as long as the buzzard was near.

AFTER THOUGHTS

There are several reports of diurnal raptors flying free [7–11] (H.-H. Beecken pers. comm.). All of these birds were kept food dependent. Otherwise, as emphasized by H. Brüll, buzzards and kestrels in their first year will go away with certainty unless they are tethered or caged before they begin to disperse in late summer or autumn.

Fridolin had been caged at that time and he had spent his second winter in an aviary near my house. He may have remembered the area when he was released at this site 5 yr later. But he was not trained and not food dependent. In winter 1980–81 he stayed away for 6 mo; he was capable of supporting himself alone.

When I last saw him on 5 February 1986 he looked healthy. Nevertheless, he may have had difficulty obtaining food. This was a hard winter. Many birds of prey starved, and the buzzard besieged us. I tried many times and trapped him at last after heavy snowfall but, probably, too late to save the kestrel.

Falconers train their birds to hunt with them. In his two-choice experiments with Red-headed Falcons (*F. chiquera*) W. Bednarek (pers. comm.) obtained positive results for color vision and pattern discrimination. Fridolin gave me a chance to observe how much kestrels are able to learn by themselves in their natural environment and in contact with other animals, including man. I suppose that the behavioral adaptability of kestrels partly depends on their cognitive abilities.

Similar experiences are reported by Frances Hamerstrom. [5 12] In her harrier book she writes "We are convinced that the female remembered our car, a tan Chevrolet roadster, and that she remembered it for a year. We visited her nest two or three times a day to empty the crops of her young for food-habit studies. She used to come toward the car when it was still a half mile away kekking her 'displeasure'. The next summer a female harrier came toward our car half a mile from her nest, kekking. When we borrowed Paul Errington's car, a dark Sedan, and drove along the same road, she ignored it. I am convinced this is a case of memory." And when Nancy, the eagle, was to get her freedom, Fran "left by moonlight so Nancy would not follow my car."

ACKNOWLEDGMENTS

Markus Martin gave me the tiercel, lent me the trap and cared for the buzzard. Mr. Biehler gave me the two females. The Forstschutzstelle Südwest allowed me to use an extended pergola of the former countryhouse for building aviaries. The Zoological Institute of Freiburg University provided a study room, the Biophysical Institute and Firma Gödecke lots of mice. Ulrike Kaufmann, Gerda Kopfmann and Vesta Stresemann served the kestrel sometimes while I was absent. Mr. Jäger collected the pellets. Marianne Kirchhofer typed the manuscript. Keith Bildstein, Joe Schmutz and Dan Varland helped to "Americanize" the text. I wish to thank all of them.—**Amélie Koehler, Wintererstrasse 29, 7800 Freiburg, Germany.**

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HAMERSTROM SCIENCE FROM A "*Gabboon's*"[1] POINT OF VIEW

The rewards of scientific work include personal gratification gained from ingenuity, satisfied curiosity, recognition, and financial gain. Recognition by scientists of work by a peer is achieved in at least three ways: by citing a person's published paper, through awards from societies or institutions, and by attributing an idea or approach to a person.[2]

Frederick and Frances Hamerstrom have fared well in all of these recognition categories. However, because even the most valuable knowledge often is vague initially and not acquired in identifiable blocks, giving recognition can be difficult. Sometimes a "seed" for an idea is acquired but this seed can mature into a slightly different idea after nurturing. Furthermore, subtly different world views or paradigms can be acquired through someone else's influence and these can play an important role in the recipient's future. Because such subtle, conceptual acquisitions often fall through the sieve of the reward system, the purpose of this special "Hamerstrom Issue" of the *Journal of Raptor Research* is to pay tribute to recognizable and subtle contributions that Fran and Hammi[3] have made. Such contributions may have been made without the full awareness of the benefactor or Fran and Hammi.

A second purpose for this essay is to examine the Hamerstroms' approach to research from a methodological perspective. I compare what I recognize to be a Hamerstromian style in biological research to other approaches in science. My interpretation will no doubt reflect more of my own perceptions than those of Fran and Hammi, for the same reasons that science ". . . is not derived solely from what is immediately apparent to the eye and ear, but is also constructed by inference from all manner of other items of information."[4]

Having been in the forefront of a number of movements within ornithology and wildlife management according to some, the Hamerstroms have also been perceived as being on the periphery of mainstream biological science by others. Forefront contributions include, for example, the insightful study of dominance among individually marked Black-capped Chickadees (*Parus atricapillus*)[5] at a time when only loosely-conceived descriptive studies were commonplace in the ornithological literature. The Hamerstroms have championed bird and mammal trapping, marking and data recording methods; they have saved a population of an endangered subspecies, the Greater Prairie Chicken (*Tympanuchus cupido pinnatus*), from extirpation through innovative ways; and have made several significant conceptual contributions to conservation and population biology.[6] Yet, some of their approaches have seemed unconventional, and their abstinence from certain experimental and statistical approaches puzzling. In an attempt to explain this potential paradox, I examine two features of the Hamerstroms' approach to biology: their emphasis on natural history with a reluctance to wax theoretical, and their aversion for using analytical statistics.

In Fran and Hammi's own words, "Speculation (properly labelled) has its place." While conservative with speculation, the Hamerstroms stressed the need for prediction.[7] However, the tying of observations into a theoretical knot through imaginative speculation was done sparingly by them. Hamerstrom science seems to resemble the approach of a kind of purist. Interpretation was conservatively applied and speculation disciplined. I have witnessed the Hamerstroms' insatiable interest in discussing observations of natural events and patterns in nature. It did not seem to matter whether those patterns dealt with raptor biology or with an attempt to map the location of a human gene on a chromosome, a project my wife carried out. However, I detected comparatively less interest in discussing what predictions would follow from parental investment theory or from evolutionary stable strategies. Why this reluctance to move out on a theoretical limb, when going beyond the collation of individual observations and into the formulation of general statements is an essential part of science?

Despite its considerable power, the scientific method has limitations. According to T.S. Kuhn,[8] "philosophers of science have repeatedly demonstrated that more than one theoretical construction can always be placed upon a given collection of data." Often no one single method of investigating the unknown is clearly best. Nor should any one method be easily discarded because it has limitations, as an unlucky "carpenter may reject his tools."[8] However, the most capable carpenter is the one who produces a useful product despite the limitations his or her tools might have. The carpenter who is fully aware of the limitations of the tool and able to compensate for them is likely to be the most capable in the long run. The Hamerstroms' execution of the craft has much to recommend it.

Perhaps the Hamerstroms' conservative approach to theory was because of an awareness of the limitations in the scientific way of knowing. Albert Einstein explained his view of how scientific discoveries are made.[9] His de-

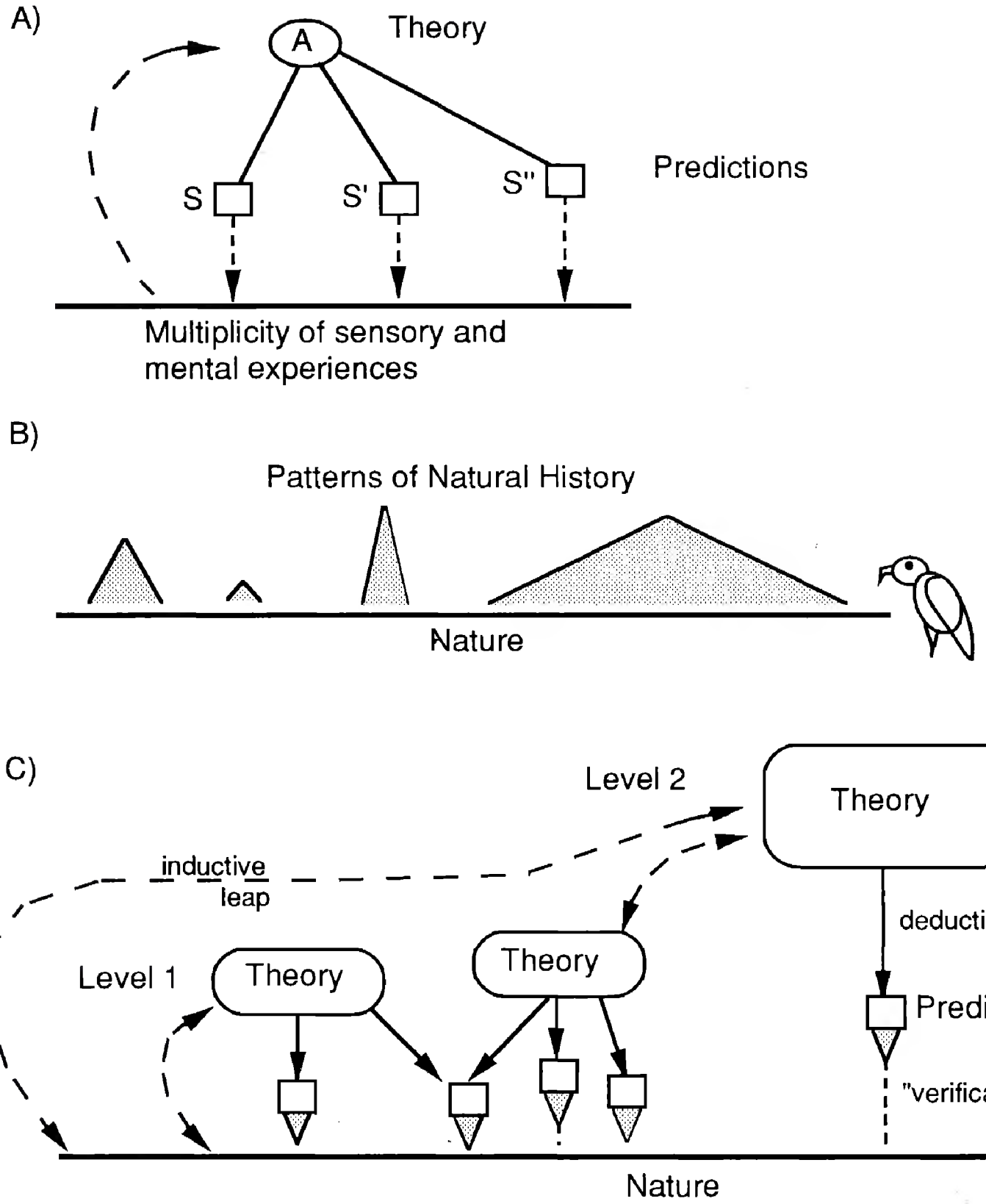

Figure 1. Three versions of how scientific discovery can be accomplished are presented. "A" is the version originally formulated by Albert Einstein, shown as adapted from G. Holton (op. cit.). Version "B" is intended to represent the Hamerstroms' style of science where data are often collected over the long term and conservatively interpreted within the context of natural history and functional ecology. Version "C" attempts to represent theoretical ecology where the source for ideas in the verification of predictions comes from theory. The connection with nature here often includes only a narrow window (e.g., short-term studies, specific data gathered; see also text).

scription went beyond the simplified textbook portrayal of the scientific method, described as hypothesis formation followed by logical deduction. Einstein recognizes four distinct components in scientific investigation which include: 1) the world around us is experienced through our senses, 2) these "sense experiences" are integrated with a person's prior conceptions and then formulated into a theory using intuition (induction), 3) logical predictions are derived from these theories (deduction), and 4) these predictions are "verified" using interpretation (Fig. 1A). The deductive connection between theory and prediction may be the strongest link in the chain of scientific discovery. Verification between prediction and reality relies on a considerable amount of interpretation and thus on the

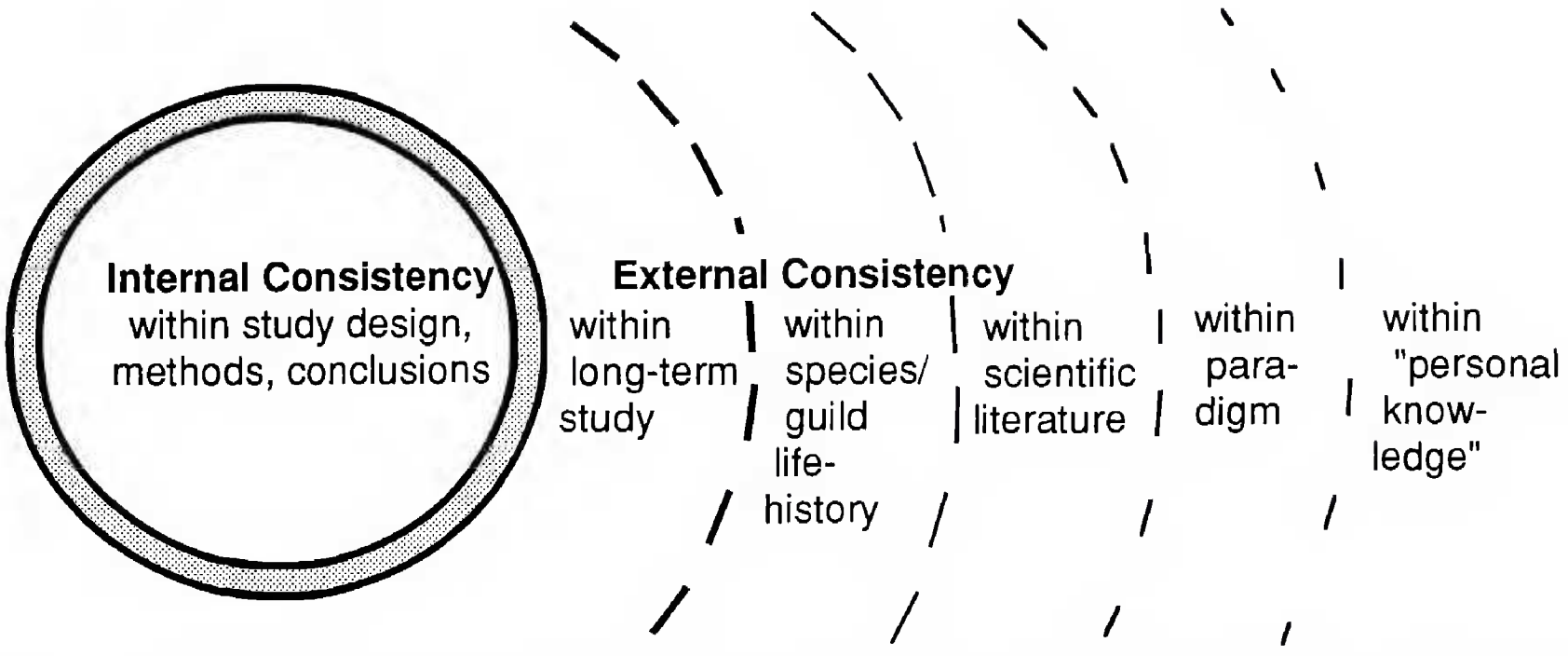

Figure 2. Different levels at which judgement of the rigor and value of an ecological investigation can be made. The levels are not mutually exclusive. See text for explanation.

accuracy of previously gained knowledge. Induction is potentially weak, because it is greatly influenced by the scientist's psychological nature. Theory is formulated through induction.

Using some or all of Einstein's components, biologists employ three identifiable approaches in research: 1) the mere description of natural events, 2) the description and explanation of repeated patterns of natural events (functional ecology) and 3) hypothesis testing. These approaches differ fundamentally. In the description of single events or patterns, the data source comes from nature. Symbolized in the form of a triangle, the triangle's base rests on the source of ideas, namely nature. The triangle's peak extends away from nature, little or far depending on the level of abstraction inherent in the interpreted explanation. The base of the triangle probably can never touch nature because the human interpreter's senses are naturally limited. These approaches (1 and 2), I believe, are compatible with the Hamerstroms' style of research (Fig. 1B). It is no coincidence that a Raptor Research Foundation award, established in the Hamerstroms' honor, recognizes individuals who have made a significant contribution to understanding the natural history of raptors.

In contrast to the description of patterns and events, in testing hypotheses the source of ideas does not come solely from nature. Ideas can be "theory-laden," derived from other theories (Fig. 1C). Testing theories that were derived from other theories and that relied on a series of *ad hoc* assumptions is not the Hamerstroms' style. When asked at the 100th annual meeting of the American Ornithologists Union in New York whether a student should concentrate on theoretical or descriptive biology, the plenary session speaker Gordon H. Orians advocated both.

In their own work, the Hamerstroms have stopped short of formulating highly abstract interpretations. As a result, many of their data went no further than the description of patterns and basic ecological interpretations. Twenty-two years of data on the behavioral ecology and population dynamics of the Greater Prairie Chicken, perhaps one of the largest and most comprehensive data sets on a natural population, have been underused from a theoretical point of view. It would appear that the Hamerstroms have shied away from using ingenuity to formulate intellectually challenging models to account for events in nature. Not so. The Hamerstroms have not down-played the mystery in nature. Instead, they have explored mystery through visual art and poetry, and sought it in music. Fran once deplored the trend in primary and secondary schools to stress the hypothetico-deductive link in scientific investigation while down-playing the personal dimension and mystery surrounding animals. Fran and Hammi feel strongly that youths should be encouraged to experience nature first hand, both out of doors[10] and within.

Another characteristic of Hamerstrom science, in addition to a reluctance to employ abstract theory, is the reluctance to employ analytical statistics. This does not mean that the Hamerstroms are uncritical in their thinking; on the contrary, critical thinking has been a prominent feature of theirs. Although statistical analysis was not a major focus in their university education, this paucity of "training" in statistical procedure has not been the determining factor in their style. They have collaborated with first-rate statisticians including F. Hilpert, G.W. Snedecor and statisticians at the Wisconsin Department of Natural Resources. Hammi and Fran have felt that the first choice was to present data in English and with revealing, legible figures. They disapproved of "cluttering any publication with non-essential mathematics." Usually, the Hamer-

stroms have delayed publication of data until the pattern was so clear that analytical statistics seemed superfluous. As a result, their investigation has been free of the constraints that are sometimes imposed by the use of statistical tools and design.

While I personally have never fully understood the reluctance by Fran and Hammi to employ a modicum of statistical analysis, their approach is well worth consideration. The issue touches on 1) what it is that makes a scientific conclusion rigorous and 2) on the sociology of scientists.

When a reader examines a manuscript, she or he can evaluate the work at many levels. These levels can be divided into two categories: internal and external consistency. An article describing the methods, results and conclusions of some investigation might be termed internally consistent if certain widely accepted criteria are met. Such criteria can include: posing a significant biological question, choosing methods that are currently accepted by peers, using and describing the methods adequately, providing conclusions that follow logically from the methods and results, and so on. Essentially, the criteria center around possible problems with the study in an internal, narrow sense. The view is "inward" with a concentration on procedure. The Hamerstroms in my view upheld many procedural expectations which included for example an elegant simplicity in the style of writing, a clarity of presentation and the use of proper terminology.

At another level (Fig. 2), a study that satisfies all or most of the procedural queries may still not "sit well" with the reader, it may be judged somehow "externally inconsistent." I have come across no scientists that have asked whether a conclusion "feels right" as often as the Hamerstroms have. This question of feeling right has sometimes elicited glib and condescending smiles.

Many nonscientists find the observation that two scientists given the same set of data can arrive at different conclusions very disturbing. Many nonscientists and scientists alike believe that knowledge is convergent; that eventually only one and the same conclusion will survive the ultimate test. The way in which scientists gain new knowledge is complicated and more tenuous than many care to admit.

The question of whether a conclusion feels right, however, has much in common with T.S. Kuhn's[11] notion of a paradigm, a fundamental guide for scientific inquiry. According to Kuhn, paradigms bridge the understanding that has been gained in the past with questions for the future. Paradigms "are the source of the methods, problem-field, and standards of solution" (p. 103). Paradigms are larger than theories because theories "must be restricted to those phenomena and to that precision of observation with which the experimental evidence in hand already deals" (p. 100). A paradigm is far less well defined than a theory and a paradigm changes as new information is gained and old information is rejected. A paradigm allows the independently thinking scientist to ask "What is my gut feeling about this?" By placing different levels of importance on each of a complex set of concepts contained within a "paradigmatic umbrella," scientists can legitimately arrive at different conclusions.

A paradigm, as a conceptual tool in making inferences through induction, may be situated close to the final explanation on an inspiration (least defined seed of an idea) to explanation (firmly defined concept) continuum. The remaining space along this continuum may be more aptly occupied by what M. Polanyi termed "personal knowledge."[12] The point is that knowledge does not simply flow directly from scientific "facts" and figures, but the information of knowledge involves a huge personal dimension. I believe that this personal dimension is largely ignored in most graduate student programs; it was valued and in evidence at the Hamerstrom household.

To think that only those who employ up-to-date statistical procedure carry out "good science" is flawed. The difficulties encountered in the study of complex natural events are so enormous that even approaches which are considered to be state-of-the-art by peers often are insufficient. S.H. Hurlbert[13] concluded that of 176 experimental studies published between 1960 and 1983, 27% were designed inappropriately. L.L. Eberhardt and J.M. Thomas[14] discuss the problems encountered in extrapolating from the "focal" to the larger "target" population in a reductionist approach. They pose the question "Should we, in some sense, revert to descriptive ecology?" Once more, the carpenter's tools have limitations. The chain is only as strong as the weakest link. Perhaps, the message from the Hamerstroms is not to use the term "chain" when the strength is equivalent to that provided by a "string." Much of what is considered "good science" is done not because the method warrants it or because a paradigm dictates it, but because it is considered the approach of choice by peers within one's "invisible college."[15]

The Hamerstroms have been highly independent in their thinking. They have been influenced little by the predominant "internal sociology of science"[16] or the "sociological setting"[17] which dictates scientific standards and procedures through consensus. For example, most geneticists agree that, when formulating a conclusion about heritability, gene-environment interactions need not be considered. This accepted omission is not because gene-environment interactions are not critical for the conclusion, but because the interactions are virtually impossible to measure. So, in many ways the "invisible college" has sanctioned a product even though the tools do not fully justify its production.

Hamerstrom science is reminiscent of a kind of investigation in natural history that is in danger of becoming extinct. L.L. Merrill[18] describes three views toward nature. The oldest view that prevailed for centuries is one in which things natural were romanticized; that which was natural was both beautiful and proper. Items contra-

dictory to this view were ignored. In the 19th century, naturalists began to examine carefully every possible detail in nature. Observations were no longer edited, but data were collected rigorously and descriptions made critically. Views and approaches became measured, rational and precise. While natural history and science were frequently taken to mean the same thing, the two disciplines gradually diverged. Beside the natural history investigations of animals, plants and minerals emerged distinct "pure" sciences such as geology, biology and others. While natural history examined all of nature, science studied only a part of nature. Science became preoccupied with examining theories. "But even in the very different computerized climate of the late twentieth century, natural history remains popular, as an abundance of widely read modern writers attests—Joseph Wood Krutch, Rachel Carson, Edwin Way Teale, Aldo Leopold, Henry Williamson, Gerald Durrell, Archie Carr, Annie Dillard, John McPhee, and David Attenborough, to name but a few."[17]

Whether the relations between what I viewed to be "Hamerstrom science" and the science described by theorists exist in actuality may be debated. Most importantly, however, the Hamerstroms have caused me to try and look ever deeper at nature, the process of science, and the interaction between science and the public. I thank Samuel J. Barry, Patrick Colgan, Reg Fleming, Fran Hamerstrom and Gordon H. Orians for their insightful comments on an earlier version of this manuscript.—**Josef K. Schmutz, Department of Biology, University of Saskatchewan, Saskatoon, SK, Canada S7N 0W0.**

LITERATURE CITED

[1] Gabboon is the Hamerstroms' term for apprentice (F. Hamerstrom 1984, Birding with a purpose: of raptors, gabboons and other creatures, Iowa State University Press, Ames, IA).

[2] For example, the "Hamerstrom scatter-pattern of management" by patches; F.N. Hamerstrom, O.E. Mattson and F. Hamerstrom 1957, A guide to Prairie Chicken management, Wildlife Bulletin 15, Wisconsin Conservation Department, Madison, WI.

[3] The Hamerstroms have signed at different times both in the English "Hammy" or the German "Hammi." They used the Bostonian or German pronunciation of "a" in Fran and Hammi.

[4] J. Ziman 1984:52, An introduction to science studies, Cambridge University Press, New York.

[5] F. Hamerstrom 1942, Dominance in winter flocks of chickadees, *Wilson Bull.* 54:32–43.

[6] E.g., F. Hamerstrom 1986, Harrier, hawk of the marshes, Smithsonian Institution Press, Washington, DC.

[7] Hammi predicted the population explosion of White-tailed Deer in Wisconsin long before it occurred—in the 1930s.

[8] T.S. Kuhn 1970:76, The structure of scientific revolutions, University of Chicago Press, Chicago, IL.

[9] G. Holton 1978, The scientific imagination: case studies, Cambridge University Press, New York.

[10] F. Hamerstrom 1975, Walk when the moon is full, Crossing Press, Freedom, CA.

[11] op cit.

[12] M. Grene [Ed.] 1961, The logic of biology, pages 191–205 *in* The logic of personal knowledge, Routledge and Kegan Paul Ltd., London, U.K.

[13] 1984, Pseudoreplication and the design of ecological field experiments. *Ecol. Monogr.* 54:187–211.

[14] 1991, Designing environmental field studies. *Ecol. Monogr.* 61:53–73.

[15] G. Holton, op. cit.

[16] J. Ziman, op. cit., p. 4.

[17] G. Holton, op. cit., p. 5.

[18] 1989, The romance of Victorian natural history. Oxford University Press, New York.

Out of the Mews

I waited
  until the moon slipped her silvery body
    behind a cloud
Barefoot
  I slid into the mews
    and spoke to my eagle—softly—not loud
In the deep of the night
  the jesses you made my eagle
    moved onto each leg
      no fright.
Oh, beautiful night.

by Fran Hamerstrom
(Reprinted from The Falconer)